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WATER HEATER

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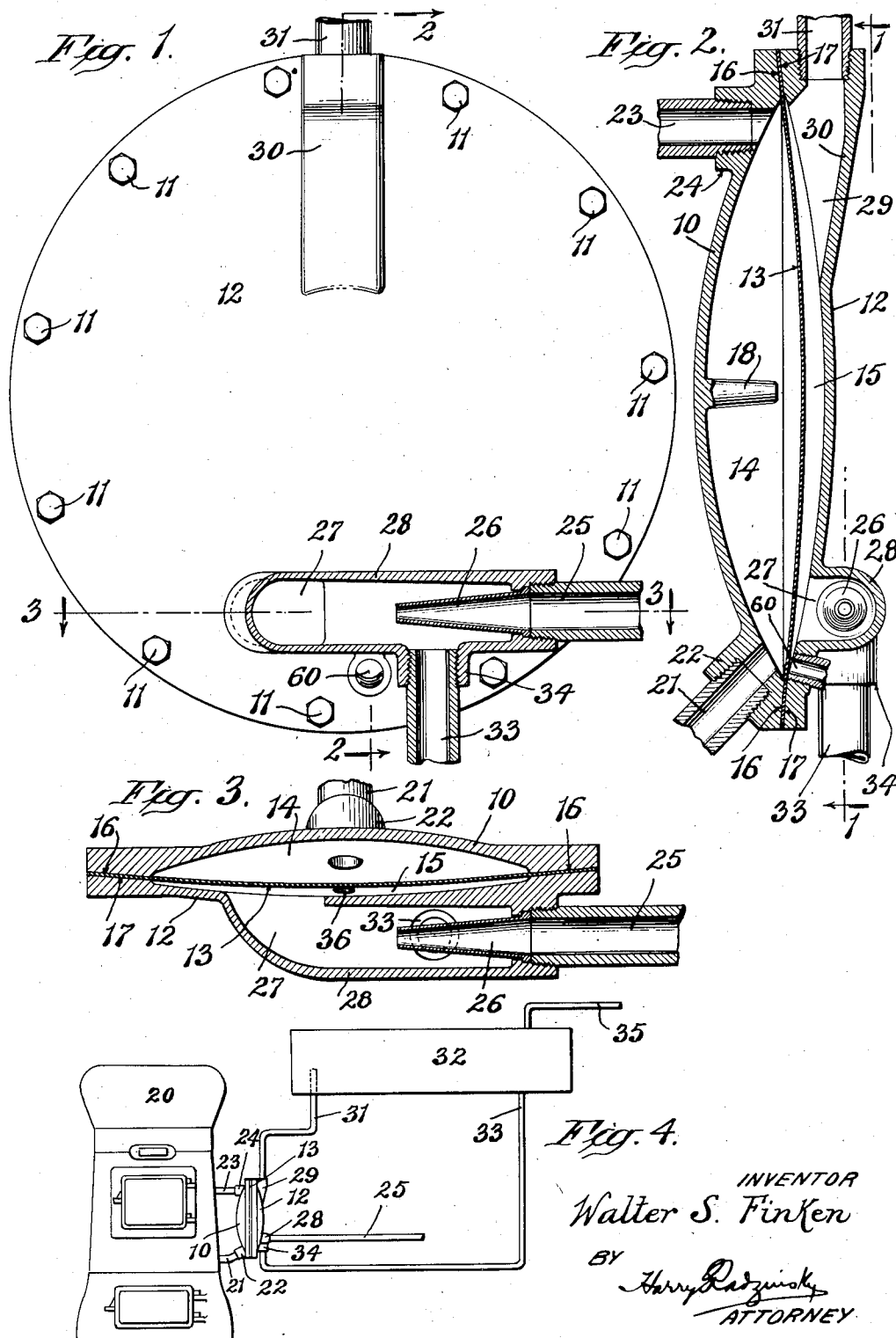


Fig. 4.

INVENTOR

Walter S. Finken

BY

Harry Radzinsky
ATTORNEY

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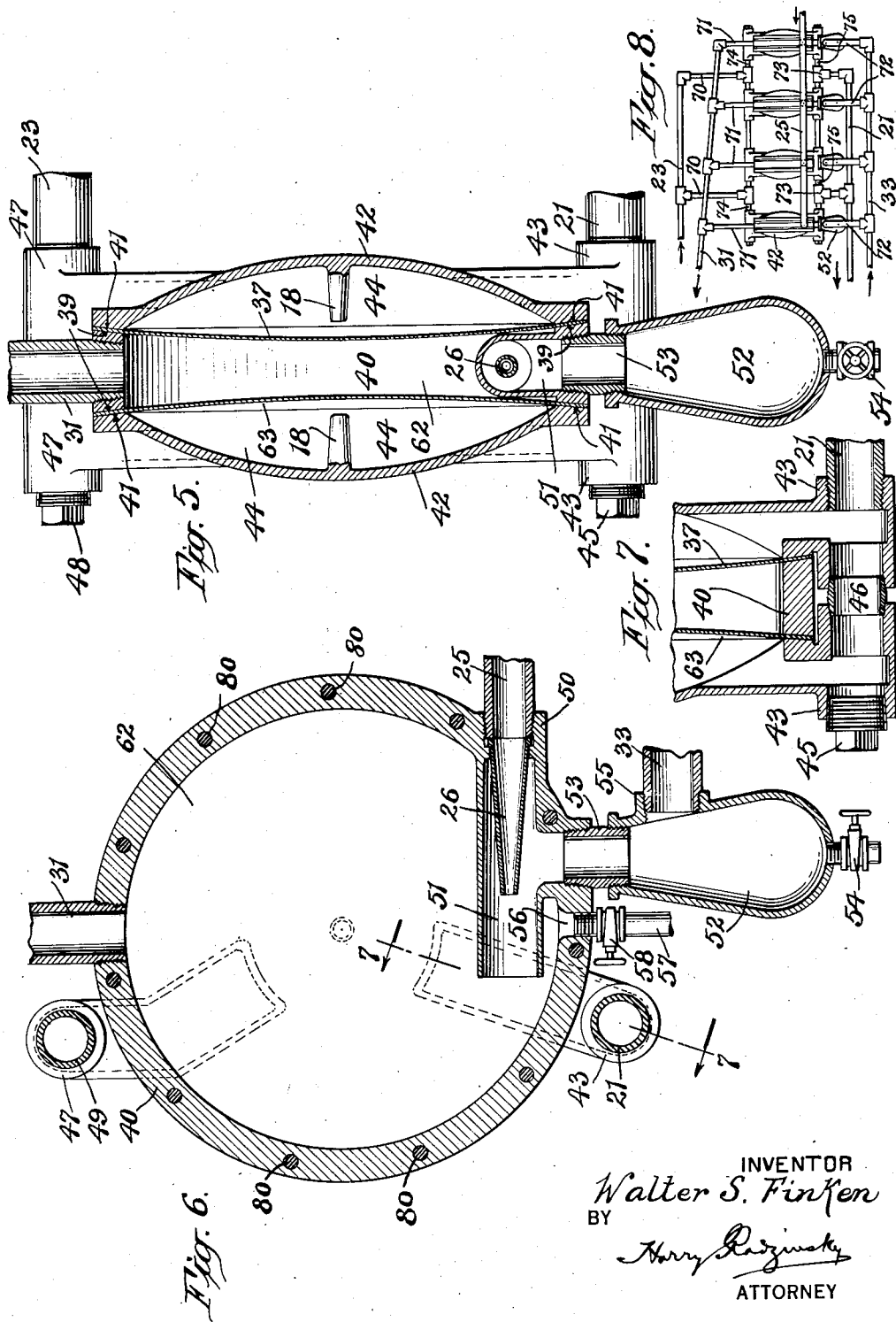
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INVENTOR
Walter S. Finken
BY
Harry Ruzinsky
ATTORNEY

UNITED STATES PATENT OFFICE

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WATER HEATER

Walter S. Finken, New York, N. Y.

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15 Claims. (Cl. 257-248)

This invention relates to an improvement in hot water heaters and to a water heating system. The object of the invention is to provide a means by which a maximum quantity of hot water is constantly supplied for household purposes, with the utilization of a minimum amount of heat.

At the present time, in hot water supply systems, a coil, often of relatively small diameter tubing, is used as the heating coil through which the water to be heated is circulated. The heating coil is usually surrounded by a jacket in which hot water from the boiler is contained and which heats the water circulating through the coil. In other structures, a gas flame is directed against the coil to heat the water passing through it. The objections to the use of such a coil and the manifold insufficiencies of the various arrangements in which coils of this kind are employed have rendered them subject to many just criticisms. The primary defect has been that sediment, rust, dirt and other foreign matter in the water, and particularly in some localities of the country, soon clogs the coil so that the passage of water through it is greatly impeded and a relatively small amount of hot water for a large amount of heat used, is obtained. Another objection found in heating coils of this character is that the time required in obtaining a sufficient amount of hot water is relatively long, and in cases where hot water is constantly in demand, delays in the use of the water are often necessary to enable the heating means to function for a sufficient time to replenish the hot water supply.

My invention, therefore, contemplates a device for heating water intended primarily for household consumption in which the defects of the now widely used heating coil are obviated; in which clogging or impedance of the hot water circulation is prevented and in which an ample supply of hot water is attained with the use of a minimum amount of fuel for heating the water. The invention also contemplates the use of an improved arrangement for circulating the hot water so that the heated water contained in the storage tank is constant in temperature, or relatively so, from the top of the tank to the bottom thereof.

These and other objects are attained by the construction fully disclosed in the following specification and more particularly pointed out in the claims.

In the accompanying drawings, forming a part hereof, Fig. 1 is a face view of a water

heater made in accordance with this invention, parts of the same being shown in section, the section being taken on the line 1-1 of Fig. 2, looking in the direction of the arrows; Fig. 2 is a sectional view of the same on the line 2-2 of Fig. 1, looking in the direction of the arrows; Fig. 3 is a sectional view on the line 3-3 of Fig. 1, looking in the direction of the arrows; Fig. 4 is a view showing the water heater connected to a boiler, a storage tank and to a source of water supply; Fig. 5 is a vertical sectional view through a double unit type of construction of water heater; Fig. 6 is a vertical sectional view through the structure of Fig. 5, the section being taken at right angles thereto; Fig. 7 is a sectional view on the line 7-7 of Fig. 6, looking in the direction of the arrows; and Fig. 8 is a view showing how a number of the units shown in Figs. 5 and 6 are connected together in cases where a relatively large quantity of hot water is consumed.

With reference to the structure shown in Figs. 1 to 4 inclusive, the heater is composed of a casing internally divided by a flexed diaphragm into two chambers, one of which contains hot water circulated through it from a boiler and used for heating, and the other chamber receives cold water from the water main. The casing is composed of a concavo-convex, disk-shaped casting 10, which is secured by the cap-screws 11, located adjacent its periphery, to another disk-shaped dished casting 12. The castings 10 and 12 are so united that their concave faces are toward one another to form a water chamber between them. Clamped between the two castings 10 and 12 is a normally flat, sheet metal flexible diaphragm 13 of disk shape, which acts as a vertical partition between the two castings and acts to separate the interior of the casing into the two separate chambers 14 and 15. The casting 10 is, near its marginal edge, provided with an annular inclined surface 16 which co-operates with a complementary surface 17 provided on the casting 12 to clamp the diaphragm 13 between them. The action of these angular or inclined surfaces 16 and 17 on the normally flat diaphragm 13 is such that it tends to buckle or bulge the diaphragm outwardly toward the inner or concave face of the casting 12 as clearly shown in Fig. 2, thus holding the diaphragm in dished shape and under tension. Water delivered from the main or house supply is circulated through the chamber 15 as will be hereafter described, and the pressure of such water on the diaphragm 13 is such that it normally tends to thrust the diaphragm

13 toward the left, as viewed in Fig. 2, and against the curvature of the diaphragm. To limit this reverse movement of the diaphragm under the pressure of the water supply, and particularly when relatively high pressure is present, a stop 18 in the form of a stud is provided on the concave face of the casting 10.

The manner in which the water heater is connected into a heating system is shown in Fig. 4. There, a boiler of a conventional heating type is shown at 20. A return pipe 21 leading from the boiler connects to a nipple 22 provided on the casting 10 adjacent the lower end of the same. A second pipe, indicated at 23 leads from the boiler and connects with a nipple 24 formed on the casting 10 adjacent its upper end. Through this arrangement, it is obvious that a continuous circulation of hot water from the boiler 20 through the chamber 14 of the heater is assured. At 25 is shown a water-supply pipe leading from the water main and terminating in an injector nozzle 26 located within a passage 27 formed in the projection 28 on the casting 12. Passage 27 leads to the interior of the chamber 15 so that cold water from the water supply is directed into said chamber from the injector nozzle 26 and fills the chamber. It will now be apparent that the hot water in the chamber 14 obtained from the boiler 20 will transmit its heat to the diaphragm 13 and the diaphragm will in turn heat the water in the chamber 15. The water in chamber 15, so heated will rise and pass out of the passage 29 formed through a projection 30 on the casting 12, said passage being connected to a pipe 31 which leads to the hot water storage tank 32 and preferably enters into the tank at the bottom. A return pipe 33 leads from the tank 32 and connects with a nipple 34 integrally formed on the projection 28 and entering into the passage 27. A pipe 35 leads from the tank 32 to the house piping.

From the foregoing, the operation of the heating device will be readily understood. Cold water enters the chamber 15 through pipe 25 and injector nozzle 26. Hot water from the boiler is circulated through chamber 14 and transmitting its heat through the diaphragm 13, it quickly heats the cold water on the opposite side of the diaphragm in chamber 15. The heated water rises from the chamber 15 to the tank 32. When faucets or taps in the house are opened to deliver hot water from the tank 32, pressure of the water in chamber 15 on the diaphragm 13 is reduced somewhat, this causing the diaphragm to flex in the direction of its curvature or to the right in Fig. 2, such flexure of the diaphragm causing any sediment then adhering to both faces of the diaphragm to drop loose, so that the diaphragm is always clean on both of its faces and the heating operation is in no manner retarded by an accumulation of foreign matter on the diaphragm. When water is being drawn off from tank 32, and the pressure of the water in chamber 15 is thus reduced, injection of cold water from the mains through injector nozzle 26 occurs. This injection causes heated water to be drawn from the tank 32 through pipe 33 by suction and such heated water enters the chamber 15 to mix with the freshly injected cold water. This arrangement, by which a circulation of the water in the tank 32 through chamber 15 and then back into the tank, is had, results in a constant maintenance of the water in the tank at a relatively uniform temperature

for the entire depth of the water there contained.

It will be seen that the circulating system described constitutes a departure from conventional practice in several ways. First, it delivers the heated water from the heating chamber 15 into the bottom of the storage tank, it being customary to deliver the heated water into the top of the tank; and secondly, it delivers the cold water supply from the water mains directly to the heating unit, rather than into the bottom of the storage tank as is the conventional practice. Through this arrangement, it has been found that a full tank of hot water is consistently maintained with a minimum of heating effort.

At the bottom of the casting 12 is an outlet 60 through which sediment, dirt and foreign matter collecting in the bottom of chamber 15 may be drawn off. A valve of conventional form may be attached to said outlet.

In the structure shown in Figs. 5, 6, and 7, two diaphragms 63 and 37 are employed. Each of these diaphragms is clamped between the angular or inclined surface 39 of an annular spacing member 40 and a complementary inclined surface 41 formed adjacent the marginal edge of a concavo-convex casing member 42. Two of the casing members 42 are employed, one being for the right side of the spacing member and the other fitting against the left side thereof, as plainly seen in Fig. 5. The casing members 42 and the diaphragms are held together by the screws 80. These casing members 42 correspond generally in structure to the casing member 10 in Figs. 1 and 2. Each casing member 42 is provided with the stop 13 for the purpose of limiting the flexure of the diaphragms 63 and 37 under the pressure of the cold water supply which enters into the spacing member 40 between the two diaphragms and is heated by contact therewith. Each of the casing members 42 has a nipple 43 projecting beyond its periphery and communicating with the interior of the casing member to reach the chamber 44. The end of one of the nipples 43 is closed by a plug 45 and the two nipples are joined by a union 46 (Fig. 7). The passage formed by connected nipples 43 and union 46 is joined to the pipe 21 leading from the boiler 20. At their upper ends each of the casing members 42 is provided with a projecting nipple 47, these two nipples being connected together to form a passage leading into the chambers 44. One end of the passage formed by the connection of the two nipples 47 is closed by the plug 48, while the other end is connected to the pipe 23 leading to the boiler. From the arrangement described, it will be seen that the hot water from the boiler is circulated through the chambers 44 and will heat the diaphragms 63 and 37 which will impart heat to the cold water in the space or chamber 62 located between these diaphragms. The spacing member 40 is provided with a connection 50 which receives the pipe 25, said connection being provided with an inwardly extending tubular passage 51 into which the injector nozzle 26 protrudes. A sediment chamber 52 is connected to the passage 51 by means of a union 53, the lower end of the sediment chamber being provided with a draw-off valve 54 through which sediment collecting in the chamber 52 may be removed. Sediment chamber 52 is formed with a laterally extending nipple 55 which receives the end of the pipe 33. Spacing member 40 is

provided with a drain opening 56 receiving a pipe 57 provided with a valve 58 through which sediment collecting in the chamber located between the diaphragms 63 and 37 can be drawn out. Pipe 31 connects with the top of spacing member 40, as shown in Figs. 6 and 7.

In operation, the structure shown in Figs. 5 to 7 inclusive, is similar to that shown in Figs. 1 and 2 and herein previously described. Hot water from the boiler fills the chambers 44, and cold water from the supply main is received in the chamber 62 located between the two diaphragms 63 and 37. The pressure of the water on the diaphragms tends to move them slightly toward their respective stops 18. When such pressure is slightly relieved, as by the drawing of water from the storage tank 32, the diaphragms will spring slightly toward their convex side, such movement acting to free the surfaces of the diaphragms from any adherent sediment, air bubbles and other elements impedimentary to the heating action. The injection of a fresh supply of cold water into the chamber 62, which occurs when water is being drawn from storage tank 32, causes water to be drawn from the tank 32 through pipe 33 to chamber 62.

In installations where a relatively large quantity of hot water is required, a number of the heating units of the construction shown in Figs. 5 and 6 may be connected together, as shown in Fig. 8. It will be there seen that the pipe 23 leading from the boiler is connected to the units by branch pipes 70 which connect into the short pipes 74 uniting the units, by the T-unions. Pipes 74 connect the nipples 47 provided on the casing members. Boiler return pipe 21 similarly connects to the units through branch pipes 73 which join with the short pipes 75 uniting the nipples 43. Pipe 31 leading from the bottom of the storage tank connects with the tops of the several chambers 62 through the branch pipes 71. Pipe 25 leading from the water supply is provided with branches, each of which carries an injector nozzle 26 and attaches to the connection 50, the injector nozzles extending into the several chambers 62 and operating as described with respect to the structure shown in Figs. 5 and 6. Pipe 33 is connected by the branches 72 to the several sediment chambers 52. The structure shown in Fig. 8 operates similarly to that where a single heating unit is used, but of course produces a greater quantity of hot water. The assembly of heating units in multiples of two can be had to any reasonable extent to meet various requirements.

In the several structures herein described, a water heating device is present in which the various defects so prominent in coil type heaters are completely obviated. Clogging of the heater by dirt, rust and sediment is rendered impossible. Rapid heating of the water is assured by reason of the large heating surface, i. e., the area of the diaphragm or diaphragms, and a rapid rise of the heated water to the storage tank occurs due to the fact that the rise of the heated water is not impeded as happens when a heating coil with turns of the coil of customary low pitch is used. The formation of air bubbles, on the surfaces of the diaphragm and the collection of dirt and sediment thereon is prevented due to flexing movement of the tensioned diaphragm when the water is drawn which movement displaces the bubbles and adherent dirt or sediment. The faces of the thin, sheet metal

diaphragm being constantly clean and smooth, easily transmit the heat of the hot water to the cold. Direct connection of the cold water inlet to the heating unit rather than to the storage tank, as in present practice, assures through action of the injector nozzle, a positive circulation of the heated water resulting in the contents of the storage tank being of substantially even temperature from the top of the tank to the bottom. These and other advantages are attained by the invention.

What I claim is:

1. A hot water heater comprising a pair of united dished casings secured together with their concave surfaces facing one another to form a water chamber, and a diaphragm flexed to concavo-convex form and held under tension and located between the casing members and dividing the interior of the chamber into separate water passages.

2. A hot water heater having a casing composed of several united casing elements, said casing having a water chamber and a flexible heating diaphragm dividing the chamber into separate passages and means on the casing elements for clamping the diaphragm between them and flexing said diaphragm into dished form by the clamping pressure.

3. A hot water heater having a casing composed of several united casing elements, an annular spacing member clamped between the casing elements, a pair of flexible heating diaphragms held between the casing elements and the spacing member, the spacing member and the diaphragms forming a cold water chamber between them, the opposite faces of the diaphragms and the casing members forming chambers for water used for heating.

4. A hot water heater comprising, a pair of disk-shaped concavo-convex casing members having their concave faces directed toward one another to form a chamber, a flexible diaphragm held between the casing members, said casing members being provided with complementary inclined surfaces near their marginal edges, said edges co-operating to clamp the diaphragm between them and flex the diaphragm.

5. A hot water heater composed of a pair of concavo-convex disks attached together with their respective concave faces extending toward one another and a thin, flexed dished sheet metal diaphragm clamped between the casing members and held tensioned therebetween and dividing the space between the casing members into two separate chambers.

6. In a hot water heater, a casing containing a diaphragm dividing the interior of the casing into two separate water chambers, means for circulating hot water through one of said chambers on one side of the diaphragm, means for circulating water to be heated through the other chamber on the opposite side of the diaphragm, and means for flexing the diaphragm to cause the same to bulge toward the chamber through which the water to be heated is circulated.

7. A hot water heater comprising, a pair of disk-shaped concavo-convex outer casing members having their concave faces directed toward one another to form a chamber, an intermediate casing member held between the outer casing members, a pair of flexible diaphragms held between the intermediate and outer casing members, said casing members being provided with co-operating inclined surfaces near their marginal edges, said edges co-operating to clamp

the diaphragms between them and flex the diaphragms toward one another.

8. A hot water heater composed of a pair of concavo-convex disks attached together with their respective concave faces extending toward one another, an annular intermediate casing member clamped between the disks, and a pair of spaced, thin flexed sheet metal diaphragms clamped between the casing members and intermediate member and dividing the space between the casing members and intermediate member into separate chambers, one of which is located between the two diaphragms.

9. A hot water heating system comprising a heating device divided into two chambers and having a flexible diaphragm located between the chambers, means for circulating hot water through one of said chambers, an injector nozzle directed into the other chamber, said nozzle being connected to a source of water supply, a storage tank, a pipe leading from the tank to the chamber to which the nozzle is connected, and another pipe leading from the tank to a location adjacent to the nozzle so that the injection of water through said nozzle will draw water from the tank and deliver it to the chamber to which the nozzle is connected.

10. A hot water heating system comprising a heating device divided into two chambers with a flexible diaphragm located between the chambers, means for circulating hot water through one of said chambers, an injector nozzle directed into the other chamber, said nozzle being connected to a source of cold water supply, a hot water storage tank, a pipe leading from the bottom of said tank to the chamber to which the nozzle is connected and another pipe leading from the tank to the same chamber and in a location adjacent to the nozzle so that the injection of water through said nozzle from the cold water supply will draw water from the tank and deliver it to the chamber to which the nozzle is connected.

11. In a hot water heater, a casing containing a flexed, disc-shaped, dished diaphragm dividing the interior of the casing into two separate water chambers, means for circulating hot water through one of the chambers on one side of the diaphragm, means for circulating water to

be heated through the other chamber on the opposite side of the diaphragm, and means on the casing operative at the marginal edge portions of the diaphragm for causing the diaphragm to bulge toward the chamber through which the water to be heated is circulated.

12. In a hot water heater, a casing containing a disc-shaped diaphragm dividing the interior of the casing into two separate water chambers, means for circulating hot water through one of the chambers on one side of the diaphragm, means for circulating water to be heated through the other chamber on the opposite side of the diaphragm, and means for holding the diaphragm under flexed tension and causing it to bulge toward the chamber through which the water to be heated is circulated.

13. In a hot water heater, a casing containing a flexed, tensioned diaphragm, said casing having a chamber on one side of the diaphragm for holding heating water and having a chamber on the other side of the diaphragm for containing water to be heated, means for causing the diaphragm to bulge toward the chamber in which the water to be heated is circulated, the pressure of said water resisting the flexing of the diaphragm and reduction in pressure of said water allowing movement of said diaphragm toward its flexed position.

14. A hot water heater comprising, a pair of casing members having concave faces directed toward one another to form a water chamber, a dished, flexible diaphragm held between the casing members and dividing the chamber into two separate compartments, means for normally holding the diaphragm in dished condition, and a stop for limiting reverse flexing movement of the diaphragm under water pressure.

15. A hot water heater comprising a chamber divided into separate water compartments by a flexible diaphragm, one of said compartments holding water under pressure, means for holding the diaphragm under flexed tension to partly resist the pressure of the water in one of the chambers so that flexing movement of the diaphragm takes place upon lessening of the water pressure on one side of the diaphragm.

WALTER S. FINKEN.